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Apr 2, 2002

US-PAT-NO: 6366800

DOCUMENT-IDENTIFIER: US 6366800 B1

TITLE: Automatic analysis in virtual endoscopy

DATE-ISSUED: April 2, 2002

## INVENTOR-INFORMATION:

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NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
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APPL-NO: 9/ 299061

DATE FILED: April 23, 1999

## PARENT-CASE:

RELATED APPLICATION This application is a continuation of application Ser. No. 08/805,584, entitled "Automatic Analysis in Virtual Endoscopy", filed on Feb. 25, 1997, now U.S. Pat. No. 5,920,319, which in turn is a continuation-in-part of application Ser. No. 08/331,352 filed on Oct. 27, 1994, now issued as U.S. Pat. No. 5,782,762, which are each incorporated herein by reference.

INT-CL: [7] A61 B 5/05

US-CL-ISSUED: 600/425; 345/419, 128/920

US-CL-CURRENT: 600/425; 128/920, 345/419

FIELD-OF-SEARCH: 600/425, 600/407, 600/410, 600/420, 600/431, 345/420, 345/419, 345/421, 345/422, 345/423, 128/920, 128/822

PRIOR-ART-DISCLOSED:

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Vining

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Vining, D.J., Padhani, A.R., Wood, S., Zerhouni, E.A., Fishman, E.K., and Kuhlman, J.E., "Virtual Bronchoscopy: A New Perspective for Viewing the Tracheobronchial Tree." Radiology. Nov. 1993, vol. 189 (P).

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ART-UNIT: 3737

PRIMARY-EXAMINER: Casler; Brian L.

ATTY-AGENT-FIRM: Dann, Dorfman, Herrell and Skillman, P.C.

## ABSTRACT:

A computer system and a computer-implemented method are provided for interactively displaying a three-dimensional rendering of a structure having a lumen and for indicating regions of abnormal wall structure. A three-dimensional volume of data is formed from a series of two-dimensional images representing at least one physical property associated with the three-dimensional structure. An isosurface of a selected region of interest is created by a computer from the volume of data based on a selected value or values of a physical property representing the selected region of interest. A wireframe model of the isosurface is generated by the computer wherein the wireframe model includes a plurality of vertices. The vertices of the wireframe model are then grouped into populations of contiguous vertices having a characteristic indicating abnormal wall structure by the computer. The wireframe model is then rendered by the computer in an interactive three-dimensional display to indicate the populations of abnormal wall structure.

14 Claims, 17 Drawing figures

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWIC
Draw	Desc	Image									

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Salido; Tiffany W.	Winston-Salem	NC		

US-CL-CURRENT: 600/425; 128/920, 345/419 .

## CLAIMS:

What is claimed is:

1. A method for automatic analysis in virtual endoscopy for interactively displaying a three-dimensional rendering of an anatomical structure having a lumen, the method comprising:

segmenting a region of interest from three-dimensional data volume obtained by a computer-controlled tomography device,

isolating a region of interest within the three-dimensional data volume prior to three-dimensional rendering,

selecting an air column as the region of interest by means of a difference in contrast between air and soft tissue, and

rendering an inside surface of an organ of interest as an outside surface of the air column corresponding to the difference in contrast between air and soft tissue.

2. The method according to claim 1, wherein the step for segmenting includes adaptively adjusting the threshold value defining the region of interest to more accurately segment specific sections of the organ during a region growing process.

3. The method according to claim 2, wherein the initial value for the adaptive threshold is -425 HU for larger airways and -800 HU for smaller airways.

4. The method according to claim 2, wherein the threshold value is varied between -425 HU and -800 HU.

5. The method according to claim 1, wherein the step for segmenting includes a three-dimensional region growing technique and an initial static threshold value.

6. The method according to claim 1, wherein the step for isolating includes modeling the isolated anatomy using a marching cubes variant algorithm.

7. A method for automatic analysis in virtual endoscopy for interactively displaying a three-dimensional rendering of an anatomical structure having a lumen, the method comprising:

introducing contrast to produce a blood-filled lumen,

segmenting a region of interest from three dimensional data volume obtained by a computer-controlled tomography device,

isolating a region of interest within the three-dimensional data volume prior to three-dimensional rendering,

selecting a blood column as the region of interest by means of a difference in contrast between blood and soft tissue, and

rendering a thin-walled soft tissue structure as an outside surface of the blood column corresponding to the difference in contrast between blood and soft tissue.

8. A method for automatic analysis in virtual endoscopy for interactively displaying a three-dimensional rendering of an anatomical structure having a lumen, the method comprising:

isolating a region of interest within the three-dimensional data volume prior to three-dimensional rendering,

selecting an air column as the region of interest by means of a difference in contrast between air and soft tissue, and

rendering an inside surface of an organ of interest as an outside surface of the air column corresponding to the difference in contrast between air and soft tissue.

9. The method according to claim 8, wherein the step for isolating includes adaptively adjusting a threshold value defining the region of interest to more accurately isolate specific sections of the organ during a region growing process.

10. The method according to claim 9, wherein the initial value for the adaptive threshold is about -425 HU for larger airways and -800 Hu for smaller airways.

11. The method according to claim 9, wherein the threshold value is varied between -425 HU and -800 HU.

12. The method according to claim 8, wherein the step for isolating includes a three-dimensional region growing technique and an initial static threshold value.

13. The method according to claim 8, wherein the step for isolating includes modeling the isolated anatomy using a marching cubes variant algorithm.

14. A method for automatic analysis in virtual endoscopy for interactively displaying a three-dimensional rendering of an anatomical structure having a lumen, the method comprising:

introducing contrast to produce a blood-filled lumen having a desired characteristic,

isolating a region of interest within the three-dimensional data volume prior to three-dimensional rendering,

selecting a blood column as the region of interest by means of a difference in contrast between blood and soft tissue, and

rendering the soft tissue structure as an outside surface of the blood column corresponding to the difference in contrast between blood and soft tissue.